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WHAT IS CLAIMED:

1.   An optical signal analyzer comprising:

a first coupler for mixing an optical reference signal and an input optical signal to be determined and generating multiple mixed signals;

a detector for detecting multiple power signals from the multiple mixed signals generated by the first coupler; and

a data processor for determining the input optical signal in the time domain from the multiple detected power signals.

2.   The optical signal analyzer in claim 1, wherein the data processor is configured to determine an amplitude and a phase of the input optical signal from the detected multiple power signals.

3.   The optical signal analyzer in claim 1, wherein

the first coupler is configured to mix the optical reference signal and the input optical signal to generate first, second, and third mixed signals,

wherein the detector is configured to detect first, second, and third power signals from the first, second, and third mixed signals, respectively, and

wherein the data processor is configured to determine the input optical signal in the time domain using the first, second, and third detected power signals.

4.   The optical signal analyzer in claim 1, further comprising:

a second coupler for mixing the reference signal and the input optical signal,

wherein the detector is configured to detect power signals from the mixed signals generated by the first and second couplers, and

wherein the data processor is configured to determine the input optical signal in the time domain from the detected power signals.

5.   The optical signal analyzer in claim 4, wherein

the first coupler mixes the optical reference signal and the input optical signal to generate first, second, and third mixed signals,

the second coupler mixes the reference signal and the input optical signal to generate fourth, fifth, and sixth mixed signals, the optical signal analyzer further comprising:

a first detector block for detecting first, second, and third power signals from the first, second, and third mixed signals, respectively;

a second detector block for detecting fourth, fifth, and sixth power signals from the fourth, fifth, and sixth mixed signals, respectively; and

wherein the data processor is configured to determine the input optical signal in the time domain using the first through sixth detected power signals.

6.   The optical signal analyzer in claim 5, wherein the data processor is configured to determine a first phasor of the input optical signal using the first, second, and third detected powers and determine a second phasor of the input optical signal using the fourth, fifth, and sixth detected powers, and

wherein the data processor is configured to determine the input optical signal in the time domain using the first and second phasors.

7.   An optical signal analyzer comprising:

a first terminal for receiving an input optical signal to be determined;

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a second terminal for receiving a reference optical signal;

a first splitter for splitting the reference optical signal into first and second reference portions;

a polarization changer for changing a polarization of the first reference portion to a first polarization state different from a second polarization state of the second reference portion;

a second splitter for splitting the input optical signal into first and second input optical signal portions;

a first coupler for mixing the first reference portion and the first input optical signal portion and generating first, second, and third mixed signals;

a second coupler for mixing the second reference portion and the second input optical signal portion and generating fourth, fifth, and sixth mixed signals;

a first detector block for detecting first, second, and third power signals from the first, second, and third mixed signals, respectively;

a second detector block for detecting fourth, fifth, and sixth power signals from the fourth, fifth, and sixth mixed signals, respectively; and

a data processor for determining the input optical signal using the first through sixth detected power signals.

8.   The optical signal analyzer in claim 7, the further comprising:

first processing circuitry for determining from the first, second, and third detected powers a first real part and a first imaginary part of the input optical signal in a first complex reference plane, and

second processing circuitry for determining from the fourth, fifth, and sixth detected powers a second real part and a second imaginary part of the input optical signal in a second complex reference plane,

wherein the data processor is configured to calculate the input optical signal using the first and second real parts and the first and second imaginary parts.

9.   The optical signal analyzer in claim 8, wherein the data processing circuitry is configured to reconstruct the input optical signal in the time domain using the calculated real and imaginary parts.

10.   The optical signal analyzer in claim 8, wherein the input optical signal is an optical carrier signal modulated with digital information.

11.   The optical signal analyzer in claim 8, wherein the first complex reference plane corresponds to the first polarization state and the second complex reference plane corresponds to the second polarization state, and

wherein the first real part and the first imaginary part of the input optical signal correspond to a first phasor and the second real part and the second imaginary part of the input optical signal correspond to a second phasor, the first and second phasors accurately representing all polarization states of the input optical signal.

12.   The optical signal analyzer in claim 8, wherein the first through third detected powers permit the first processing circuitry to determine both amplitude and phase of the input optical signal in the first complex reference plane, and

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wherein the fourth through sixth detected powers permit the second processing circuitry to determine both amplitude and phase of the input optical signal in the second complex reference plane.

13.   The optical signal analyzer in claim 7, wherein the signal detected by each of the first through sixth detectors is at a beat frequency corresponding to a difference in frequency between the input optical signal and the reference optical signal.

14.   The optical signal analyzer in claim 7, wherein the first through sixth detected powers provide both amplitude and phase information needed to determine the input optical signal.

15.   The optical signal analyzer in claim 7, wherein each of the detectors includes:

a photodetector;

an amplifier for amplifying an output of the photodetector;

an analog to digital converter for converting the amplified output into digital power signal information; and

a buffer for storing the digital power signal information.

16.   A method for analyzing an unknown optical signal comprising:

(a) mixing an optical reference signal and an input optical signal to be analyzed to generate multiple mixed signals;

(b) detecting multiple power signals from the mixed signals; and

(c) determining the input optical signal in the time domain from the multiple detected power signals.

17. The method in claim 16, wherein the determining step (c) includes determining an amplitude and a phase of the input optical signal from the detected power signals.

18. The method in claim 16, wherein the mixing step (a) includes mixing the optical reference signal and the input optical signal to generate first, second, and third mixed signals,

wherein the detecting includes detecting first, second, and third power signals from the first, second, and third mixed signals, respectively, and

wherein the determining step (c) includes determining the input optical signal in the time domain using the first, second, and third detected power signals.

19. The method in claim 16, wherein the mixing step (a) includes mixing the optical reference signal and the input optical signal to generate first, second, third, fourth, fifth, and sixth mixed signals,

detecting in a first detector block first, second, and third power signals from the first, second, and third mixed signals, respectively;

detecting in a second detector block fourth, fifth, and sixth power signals from the fourth, fifth, and sixth mixed signals, respectively, and

wherein the determining step (c) includes determining the input optical signal in the time domain using the first through sixth detected power signals.

20. The method in claim 19, wherein the determining step (c) includes determining a first phasor of the input optical signal using the first, second, and third detected powers, determining a second phasor of the input optical signal using the fourth, fifth, and sixth detected powers,

and determining the input optical signal in the time domain using the
first and second phasors.

21.   The method in claim 20, further comprising:

calibrating the first detector block to determine an amplitude
correction and a phase correction for each detector in the first detector
block, and

calibrating the second detector block to determine an amplitude
correction and phase correction for each detector in the second detector
block.

22.   The method in claim 21, further comprising:

detecting at the calibrated first detector block first powers
corresponding to plural polarization states of the reference signal;

detecting at the calibrated second detector block second powers
corresponding to plural polarization states of the reference signal; and

using the first and second powers corresponding to the plural
polarization states of the reference signal to convert subsequent detected
powers from the first and second detector blocks into an ortho-normal
complex plane.

23.   The method in claim 16, further comprising:

calibrating a tunable laser generating the reference signal to
determine a difference between a set frequency of the laser and an actual
frequency of the reference signal produced by the laser over a frequency
range of interest.

24.   The method in claim 19, further comprising:

determining a frequency response for each of the first and second
detector blocks;

determining a time domain impulse response for each of the first and second detector blocks from its corresponding frequency response;

generating a Green's function using the time domain responses; and

using the Green's function to transform the detected signals into the input signal.

25.   A method for analyzing an optical signal comprising:

receiving an input optical signal to be determined;

receiving a reference optical signal;

splitting the reference optical signal into first and second reference portions;

changing a polarization of the first reference portion to a first polarization state different from a second polarization state of the second reference portion;

splitting the input optical signal into first and second input optical signal portions;

mixing the first reference portion and the first input optical signal portion and generating first, second, and third mixed signals;

mixing the second reference portion and the second input optical signal portion and generating fourth, fifth, and sixth mixed signals;

detecting first, second, and third power signals from the first, second, and third mixed signals, respectively;

detecting fourth, fifth, and sixth power signals from the fourth, fifth, and sixth mixed signals, respectively; and

determining the input optical signal using the first through sixth detected power signals.

26.   The method in claim 25, the further comprising:

determining from the first, second, and third detected powers a first real part and a first imaginary part of the input optical signal in a first complex reference plane;

determining from the fourth, fifth, and sixth detected powers a second real part and a second imaginary part of the input optical signal in a second complex reference plane; and

calculating the input optical signal using the first and second real parts and the first and second imaginary parts.

27.   The method in claim 26, wherein the calculating includes reconstructing the input optical signal in the time domain using the calculated real and imaginary parts.

28.   The method in claim 26, wherein the input optical signal is an optical carrier signal modulated with digital information.

29.   The method in claim 26, wherein the first complex reference plane corresponds to the first polarization state and the and the second complex reference plane corresponds to the second polarization state, and

wherein the first real part and the first imaginary part of the input optical signal correspond to a first phasor and the second real part and the second imaginary part of the input optical signal correspond to a second phasor, the first and second phasors accurately representing all polarization states of the input optical signal.

30.   The method in claim 26, wherein both amplitude and phase of the input optical signal in the first complex reference plane are determined using the first through third detected powers, and

wherein both amplitude and phase of the input optical signal in
the second complex reference plane are determined using the fourth
through sixth detected powers.

31.   The method in claim 25, wherein each of the first through
sixth detected signals is at a beat frequency corresponding to a
difference in frequency between the input optical signal and the
reference optical signal.

32.   The method in claim 25, wherein the first through sixth
detected powers provide both amplitude and phase information needed
to determine the input optical signal.

33.   A method of calibrating for use in an optical signal
detector including a reference source, a first coupler for mixing an input
optical signal with the reference signal, a first detector block for
detecting first, second, and third power signals output from the first
coupler, comprising:

    determining amplitude and phase corrections for the first detector
block, and

    generating a calibration matrix for the first detector block using
the determined amplitude and phase corrections.

34.   The method in claim 33, wherein the determining step
further comprises:

    sweeping the reference signal across a range of different
wavelengths;

    acquiring detected powers at the first detector block as a function
of wavelength, each detected power having a high frequency
component;

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calculating phase differences between detectors in the first detector block using the corresponding acquired high frequency components;

sweeping the reference signal across a range of different wavelengths without an input signal;

acquiring detected powers at the first detector block as a function of wavelength, each detected power having a low frequency component; and

calculating amplitude differences between detectors in the first detector block using the corresponding acquired low frequency components,

wherein the calibration matrix for the first detector block is determined using the calculated phase differences and amplitude differences.

35.   The method in claim 33, wherein the calibration matrix is generated in an arbitrary reference system, the method further comprising:

converting the calibration matrix from the arbitrary reference system into a complex plane reference system.

36.   The method in claim 33, further comprising:

using the calibration matrix to calibrate the first detector block.

37.   The method in claim 33, wherein the optical signal detector further includes a second coupler for mixing an input optical signal with the reference signal in a different polarization state and a second detector block for detecting fourth, fifth, and sixth power signals output from the second coupler, comprising:

determining amplitude and phase corrections for each of the first
and second detector blocks, and

generating a calibration matrix for each of the first and second
detector blocks using the determined amplitude and phase corrections.

38.   The method in claim 37, wherein the determining step
further comprises:

sweeping the reference signal across a range of different
wavelengths;

acquiring detected powers at the first and second detector blocks
as a function of wavelength, each detected power having a high
frequency component;

in each of the first and second detector blocks, calculating phase
differences between detectors;

sweeping the reference signal across a range of different
wavelengths without an input signal;

acquiring detected powers at the first and second detector blocks
as a function of wavelength, each detected power having a low
frequency component; and

in each of the first and second detector blocks, calculating
amplitude differences between detectors,

wherein the calibration matrix for each of the first and second
detector blocks is determined using the phase differences and amplitude
differences calculated for its corresponding detector block.

39.   The method in claim 37, wherein each calibration matrix
is generated in an arbitrary reference system, the method further
comprising:

converting each calibration matrix from the arbitrary reference system into a complex plane reference system.

40.   A method of calibrating for use in an optical signal detector including a reference source, a first coupler for mixing an input optical signal with the reference signal in a first polarization state, a second coupler for mixing an input optical signal with the reference signal in a second polarization state, a first detector block for detecting first, second, and third power signals output from the first coupler, a second detector block for detecting fourth, fifth, and sixth power signals output from the second coupler, comprising:

generating the reference signal at different polarizations;

detecting powers at each of the first and second detector blocks to generate a complex vector at each different reference signal polarization; and

generating a vector calibration matrix using the complex vectors generated for each of the reference signal polarizations.

41.   The method in claim 40, wherein the reference signal is generated at four different polarizations.

42.   The method in claim 40, further comprising:

using the vector calibration matrix to convert subsequently detected powers at the first and second detector blocks into an ortho-normal coordinate system.

43.   A method of calibrating for use in an optical signal detector including a reference source, a first coupler for mixing an input optical signal with the reference signal, a first detector block for

detecting first, second, and third power signals output from the first

coupler, comprising:

    sweeping the reference signal across a range of different

wavelengths;

    passing a portion of the reference signal through two different

length paths;

    coupling the reference signal from the two different length paths

and generating at least two power outputs;

    detecting the two power outputs as a function of wavelength; and

    determining a frequency correction to be applied to when

generating the reference signal using the detected outputs.

44.   The method in claim 43, wherein the determining step

includes determining an power amplitude difference and a phase

difference between the two detectors.

45.   The method in claim 43, wherein the determining step

further includes determining an average power amplitude variation and a

peak-to-peak power amplitude variation.

46.   A method for reconstructing an optical signal for use in an

optical signal detector including a reference source, a first coupler for

mixing an input optical signal with the reference signal in a first

polarization state, a second coupler for mixing an input optical signal

with the reference signal in a second polarization state, a first detector

block for detecting first, second, and third power signals output from the

first coupler, a second detector block for detecting fourth, fifth, and sixth

power signals output from the second coupler, comprising:

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determining a frequency response for a bandwidth of each of the
detector blocks, where the bandwidth of the detector blocks is
substantially less than the bandwidth of the optical signal;

determining a time domain impulse response of each detector
block from its corresponding frequency response;

using the impulse response to create a Green's function that
relates the input optical signal as a function of time and a measured
signal determined from the detected powers as a function of time.

47.   The method in claim 46, further comprising:

inverting the Green's function, and

using the inverted Green's function to convert the measured
signal into the optical signal.